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ABSTRACT

The Internet-Based Shared Environment for Expeditions (iExpeditions) is both a development effort of the Center for Technology Innovations in Education, University of Missouri, Columbia, and a research project conducted in partnership with Motorola, Inc. and a researcher at Brigham Young University (Utah). The project seeks to develop and understand the use of computer-supported collaborative learning (CSCL) technologies for supporting distributed learning communities via the World Wide Web. In the expedition examined, participants were challenged to come up with solutions on how to design, develop, and market wireless communication for cars, providing drivers with personalized information, messaging, entertainment, and location-specific travel and security services. Participants conducted their activities through a Web site providing a coordinated set of CSCL tools facilitating communication, information access, collaboration, and knowledge representation. Participants were 45 youth (children of Motorola employees) from 13 to 17 years old. Research questions addressed the learning experiences of participants, the teaching experiences of online mentors, and the function of the CSCL tools. Data were collected through online non-participant observation, electronic surveys, questionnaires, interviews, chat room observation, transcripts of forum entries, and project artifacts collection. Results show that substantial associations exist among youths' attributions, interest and participation, and team functioning. Contains 21 references. (MES)

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How do Youth and Mentors Experience Project-based Learning in the Internet-based Shared Environment for expeditions (iExpeditions)

The Internet-based Shared Environment for Expeditions (iExpeditions) is both a development effort of the Center for Technology Innovations in Education (CTIE), University of Missouri, Columbia, and a research project conducted in partnership with Motorola, Inc. and a researcher at Brigham Young University. The project seeks to develop and understand the use of computer-supported collaborative learning (CSCL) technologies for supporting distributed learning communities via the web. Koschmann (1996) regarded CSCL as an emerging paradigm in instructional technology. It focuses on the use of technology as mediational tools within a collaborative methods of instruction.

"Expedition" is a metaphor for participant's involvement in a team problem-solving activity. In the expedition examined, participants were challenged to come up with solutions on how to design, develop and market telematics. Telematics is wireless communication designed for cars providing drivers with personalized information, messaging, entertainment and location-specific travel and security services. The entire expedition lasted eight weeks from April 28th to June 15th of 1999. Each week participants needed to accomplish a milestone, which contained several problem statements called challenges. Challenges were distributed by the mentors to the youth as a special type of document inserted in their expedition log. Participants conducted their activities through a web site providing a coordinated set of CSCL tools facilitating their communication, information access, collaboration and knowledge representation.

Forty-five youth (children of Motorola employee) from 13 to 17 years old who responded to an invitation for the expedition were selected to participate. Selection was based on the youth having sufficient access to technology (primarily a modern computer and Internet access). They were divided into nine groups of five, and approached the Expedition activities under the guidance of online mentors.

Purpose of the study and research questions

Because of the importance the researchers placed on building theory from the understandings of the participants in CSCL, the main purpose of this study was to better articulate the experiences of the youth and mentors in iExpeditions. The main research question was: "How do youth and mentors experience project-based learning in an Internet-based Shared Environment for Expeditions (iExpeditions)?" The

expectations for how youth and mentors would work and the methodology for studying their experiences were derived from a review of literature on computer-supported collaborative learning (CSCL), project-based learning, online learning environments and educational computer-mediated communication (CMC).

Progressive research questions addressed in the pilot study covered three dimensions of this project: the learning experiences of Motorola youth; the teaching experiences of online mentors; and the function of the CSCL tools.

Youths:

1. In what ways and to what extent do the youths become engaged in an Expedition?
2. What outcomes and to what extent are outcomes achieved in an Expedition?

Mentors:

3. What are the well-facilitated moments of mentors?
4. How do mentors' attitudes, beliefs towards CSCL tools affect youths' learning?

CSCL tools:

5. How well does the set of CSCL tools (primarily iExpeditions) support engagement and achievement in an expedition?
6. How well do CSCL tools support mentors in fulfilling their roles as related to youths' learning? And, in what ways can these tools be improved?

Research design

This study is an interpretative case study (Yin, 1989). The iExpeditions project is framed as a single case, with the individual teams, a sample of 10 to 15 youth in these teams, four to five mentors guiding those teams, and the weekly expedition activities as embedded cases. A case study is an empirical inquiry that focuses on understanding the dynamics of a contemporary phenomenon within its real-life context and that uses multiple sources of evidence (Yin, 1989). An interpretative case study is an intensive description and analysis of a single instance, phenomenon, or social unit. In case studies, the researcher explores a single entity or phenomenon bounded by time and activity and collects detailed information by using a variety of data collection procedures during a sustained period of time (Merriam, 1988; Yin, 1989).

For this study, the researchers followed the case study procedures outlined by Yin (1994):

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(1) generating the research questions of what and how;

(2) identifying the purpose of the study;

(3) specifying the unit of analysis;

(4) establishing the logic linking the data to the propositions;

(5) explaining the criteria for interpreting the findings when writing the results.

Method

Data collection

The researchers' inspection of system use and interviews with the youth and mentors were the primary instruments for data-collection. In addition, existing instruments, tests, and self-designed questionnaires and surveys were used as supplementary instruments for data-collection. The existing instruments include: Collins Attitude Towards Computer Scale (CACS), Children's Nowicki-Strickland Internal-External Locus of Control Scale (Nowicki & Strickland, 1973); Kolb's learning style inventory (Smith & Kolb, 1986), modified Spielberger's Self-Evaluation Questionnaire about Computer Anxiety (Gaudry & Spielberger, 1971). The researcher-designed tools include: questionnaire on technology infrastructure, questionnaire on technology experience, youths' weekly self-report challenge cards; and mentors' weekly evaluation of youths' participation.

In this study, data were collected in various ways: online non-participant observation, electronic surveys (youths' weekly self-report, mentors' evaluation of youths' participation), questionnaires, interviewing (telephone and in person), chat room observation, transcripts of forum entries, and project artifacts collection. The primary sources of data were the electronic logs and notes among youth and mentors as captured in the iExpeditions tool.

Data were collected on a timely and systematic manner. Besides following the timeline as originally planned, chat sessions were set up with mentors when needed to get in-depth information on themes emerged. Data collected were input into a case study data base-- Pilot iExpeditions Data Inventory.

Data analysis

Both data collection and analysis in the case study were guided by grounded theory (Strauss & Corbin, 1998), which is "a general methodology for developing theory that is grounded in data systematically gathered and analyzed" (Strauss & Corbin, 1994, p. 273). The purpose of this methodology

is to develop theory, through an iterative process of data analysis and theoretical analysis, with verification of hypotheses ongoing throughout the study. Key methodological features of this design are:

- the constant comparison of data with emerging categories;
- theoretical sampling of different groups to maximize the similarities and the differences of information;
- systematic coding (open, axial, & selective);
- and the description of the nature of relationship between variables by asking questions of data. (Strauss & Corbin, 1997).

Beginning with data collection, the pilot relied on continuous comparison of data and theory and emphasizes the emergence of theoretical categories solely from evidence. The data analysis was both an inductive and deductive process for generating theory grounded firmly in the lived experience of the informants.

Data were analyzed simultaneously when they were being collected. This frequent overlap helped the researchers adjust to the new emerging themes and the research instruments, and be flexible in data collection. The researchers looked for emerging themes, and then used them as guide for further data-collection in finding and refining patterns. This sequence continued until no new patterns emerged. The categories and patterns were integrated into the preliminary conceptual framework or the model when data collection was near completion, so to make sure that it is "grounded" in the phenomena.

The pilot data were analyzed by combining a case study approach and the grounded theory method. The grounded theory analysis consists of open coding, axial coding, selective coding, and the generation of a conditional matrix (Strauss & Corbin, 1998). The researchers in this process attempts to saturate categories through constantly comparing incidents with incidents until categories emerge and through the theoretical sampling of informants that leads to the development of categories and theories. In case study design directed by grounded theory, literature review, question or hypothesis generation, data collection and analysis occur simultaneously.

Computer-assisted data-analysis software, NUD*IST and SPSS, were used to analyze the different data types. SPSS was used to analyze quantitative data, e.g., attitudinal measure, locus of control test and self-evaluation questionnaire. NUD*IST is a software package developed by Sage Publications which aides in analyzing qualitative data through identification of common patterns. NUD*IST provides flexibility

for the researchers by allowing raw data (in this case online student messages) to be studied by text units consisting of words, sentences or paragraphs; this study was concerned with both words and sentences consisting of each online student messages. NUD*IST was the primary tool for analyzing data obtained by document gathering, participant observations, open-ended questionnaires, and semi-structured interviewing.

Qualitative data were transcribed and imported into NUD*IST for open coding, which is a line-by-line analysis for identifying major concepts and categories. In open coding, data were coded descriptively and interpretively. The categories generated in the open coding process were then linked to their subcategories according to common themes and shared relationships that is known as axial coding. The researchers then conducted selective coding, which is the process of selecting a core category and relating it to the main categories that emerge from the open and axial coding. The process of youths' engagement in the project, the process of problem-solving, the forming of a learning community, and their attitudinal achievements were examined by focusing on action/interaction components of the following paradigm model:

(A) Conditions->(B) Actions/interactions->(C) Bring in changes to conditions->(D) Result in the next action/interaction (Strauss & Corbin, 1998).

During the process analysis, the researchers frequently compared episodes to episodes, events to events, and categories to concepts, so as to discover patterns of happenings, events, or actions/interactions, and made relational statements among the structural conditions, actions/interactions, and consequences. The patterns and relational statements were turned into a hypothetical model explaining the project-based learning in the iExpeditions, and then validated and further elaborated through continued comparisons of data. In addition to detailed coding of collected data, a qualitative content analysis approach was also used to analyze documents gathered during the theory-building process, so as to verify theoretical relationships discovered.

The qualitative methods were also combined with efforts to quantify the experience of youth, such as the amount of participation/interaction, the number of journal entries, rubrics for judging outcomes, self-ratings provided by the youth and rating provided by mentors.

The preliminary model generated was compared with extant models for similarities and conflicts, i.e., the effective dimensions of Web-based instruction (Reeves, 1999); a model of Web-based collaboration (Shrage, 1991); a motivational framework (Duchastel, 1997); Attributes of the Web (Hackbarth, 1997); and a new paradigm for distance education (Mason and Kaye, 1990b).

Results

Attribution. Attributions refer to the sense that the youth make of their experience that includes sense of audience, task authenticity and ownership and mental models. Do youth have a sense of ownership? Do they feel that the challenges are authentic? Who do they feel is the audience for their work? What personal goals have they developed for their efforts in the expedition? These attributions are essentially the meaning that the youth develops of the expedition along key dimensions that are thought to relate to activity and accomplishment.

(1) Sense of audience. Reeves (1999) argued that "[t]he capacity to share knowledge and creations with anyone anywhere in the world can be harnessed in higher education to give students a powerful sense of audience" (p. 3). In this study, most youths' sense of audience was limited to Motorola employee, their mentors or team members. Few youth were aware of the existence of other teams. There was no evidence of team competition.

(2) Task authenticity and ownership. Cognitive learning theory indicates if knowledge, skills, and attitudes are learned in an authentic contexts, they will be used in contexts similar (Khan ed., 1997). By emphasizing authentic tasks that students 'own' for themselves, web-based instruction can be designed to enhance the transfer of knowledge and skills (Khan, 1997). In this study, youths' sense of authenticity and ownership increased each week when they were more involved in team activities. A stronger sense of task authenticity and ownership in turn increased youths' level of interest and frequency of participation.

(3) Mental models are the mental structures used to "understand systems and solve problems arising from the way systems work (Winn & Snyder, 1996, p. 123). Early field studies on networked learning environments suggest that it is important that participant form mental models of the "spaces" where they are working (Harasim, Calvert, & Groeneboer, 1997). The iExpeditions youth developed mental models of the expedition activity process, of the

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iExpeditions tools, and of the problem-solving process. Youth that formed more than one of the three mental models showed a higher level of interest and a higher frequency of participation.

Interest and participation. Youths' interest level and frequency of participation changed over the eight weeks. Figure 1 indicates youths' interest level towards expedition on a scale of one (low) to five (high). Y002, Y001 in the horizontal line represent individual youth. The red line shows the interest level of the first week, the green line shows the interest level of the second week, and the blue line is for weeks three to six. The line comparison indicates the increasing of youths' interests from the first week to the six week.

Youths' interest in expedition for the first two weeks ranged from one (low) to five (high), with most in three and four. Some thought it was interesting; some were not sure yet; some felt it was not interesting and fun as expected but hope it would become interesting in the following weeks. Y011 believed that it would make things more interesting if more teammates were there. For Y022, the first-week expedition "isn't really that interesting yet, but it will probably be more fun after I get the charge from Chris Galvin. I haven't made any contributions to the team yet but I am going to **try harder** to give positive contributions to the team." Y002 commented on his first self-report card that, "[t]he expedition is very interesting and fun but the time it takes is very long, because it at least takes one web page a min to load up. I don't think I'm contributing but I'm trying to."

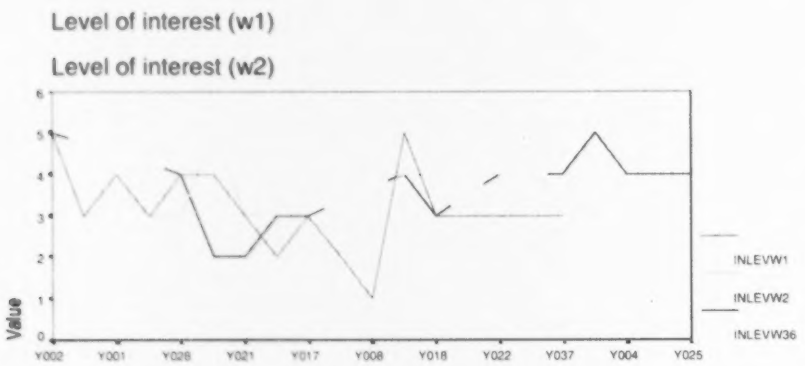

Figure 1. Level of interest

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When youths' level of interest increases, their frequency of logging in to the web site also went up from once or twice a week to four times a week or even daily.

Team functioning. Team functioning refers to the effectiveness of teamwork that was measured by the participation and contributions of team members in individual work and teamwork, the forming of team interdependence, the progress of teamwork and the evidence of team evaluation. Team functioning fluctuated during the eight weeks with youths' frequency of participation. Team functioning were considered as high when more than half of the team members completed individual work, or participated in team chats, log creation, or forum discussion.

Discussion

In grounded theory, Strauss and Corbin (1990) suggest that the development of a theory is the culminating aspect of a study. This theory might be presented as a visual representation of relationships among concepts. A model of Youths' Attributions, Interest and Participation, and Team Functioning in CSCL-mediated Project-based Learning (see Figure 2) was constructed from a detailed, recursive analysis of the eight-week expedition data. It is grounded by uncovering patterns in the data through a process of gathering information, asking questions, forming categories, looking for patterns, and then developing a model and comparing it with other theories (i.e., the existing model of web-based instruction).

The pilot data and related literature suggested that substantial associations exist between youths' attributions, interest and participation, and team functioning. Attributions influence the **interest and participation** of the youth in the expedition and how well the **teams function** in advancing through the expedition. For instance, youths' perceptions and understandings of the expedition activities affected their interest and participation patterns. Youths' interest and participation contributed to high team functioning, which in turn increased their interest and participation. This explanatory model informed the investigation of participant interaction in the second expedition by providing youths' attributions, interest and participation and team functioning as social contexts within which the interaction has happened. The model explains the interrelations of variables in the three categories. It is incompletely conceptualized and is being validated through the study on the second expedition.

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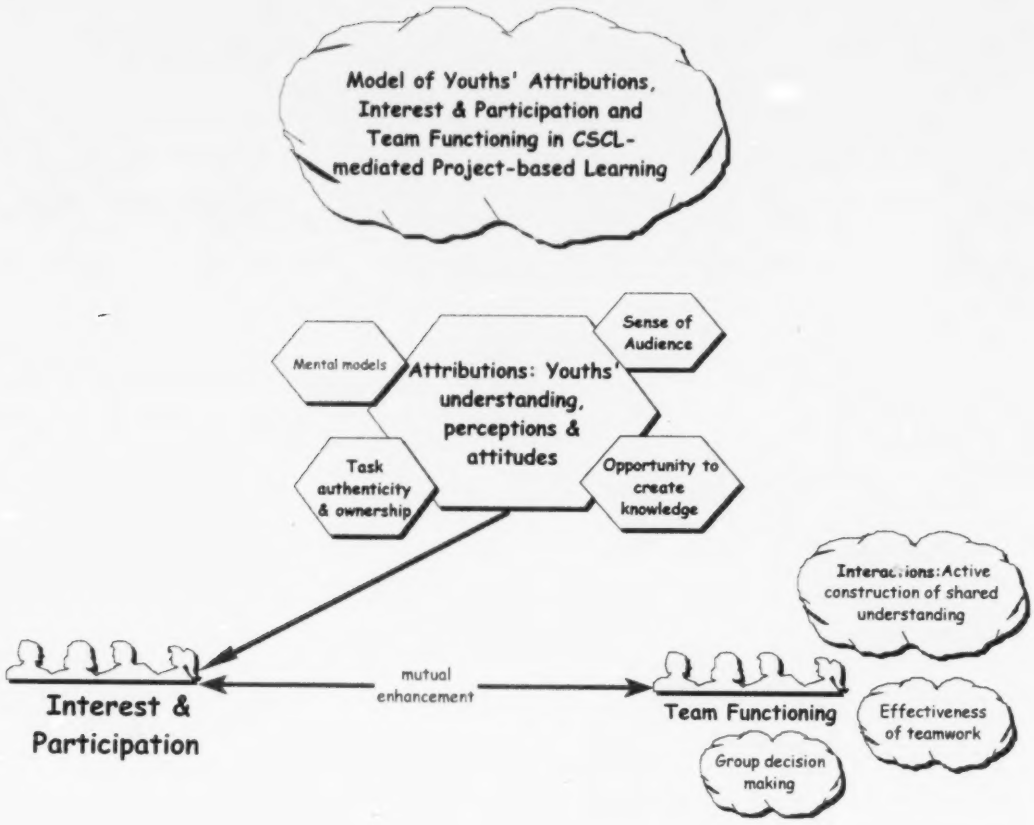
Model of Youths' Attributions, Interest & Participation and Team Functioning in CSCL-mediated Project-based Learning
Mental models
Attributions: Youths' understanding, perceptions & attitudes
Sense of Audience
Task authenticity & ownership
Opportunity to create knowledge
Interactions: Active construction of shared understanding
mutual enhancement
Interest & Participation
Team Functioning
Effectiveness of teamwork
Group decision making

Figure 2. A Model of Youths' Attributions, Interest and Participation and Team Functioning in CSCL-mediated Project-based Learning (Check the figure format).

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